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VISIT TO NORTHEAST B.C. COAL MINES

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VISIT TO NORTHEAST B.C COAL MINES

by

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ABSTRACT

Two mines in Northeast B.C were visited to study the operations in detail and discuss with the management the problem areas requiring R & D effort.

The Northeast B.C coal area was officially opened in June, 1984. The two mines operational at present are: Quintette and Bullmoose. Denison Mines (through its subsidiary Quintette coal) manages the larger Quintette mine. Teck Corporation has 51% interest and manages the other. An open-pit mining method utilizing shovel/truck system is employed at both mines. A total volume of 7.7 Mt coal per year (Quintette - 6.0 Mt and Bullmoose - 1.7 Mt) is supplied to the Japanese customers.

This report summarizes the discussions held with the two mines and highlights potential areas of research to enhance mine productivity.

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VISITE DES MINES DE CHARBON DU NORD-EST DE LA C.-B.

par

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RÉSUMÉ

On a visité deux mines du nord-est de la C.-B. afin d'étudier l'exploitation en détail et de discuter avec la direction des problèmes qui nécessitent des travaux de R & D.

L'ouverture officielle de la région houillère du nord-est de la C.-B. a eu lieu en juin 1984. Les mines Quintette et Bullmoose sont les deux mines en exploitation à l'heure actuelle. Denison Mines, par l'intermédiaire de sa filiale Quintette Coal, dirige la mine Quintette de taille plus grande. Teck Corporation détient 51 % des intérêts et gère l'autre. Les deux mines utilisent une méthode d'exploitation à ciel ouvert au moyen d'un système camion-pelle. Un volume total de 7,7 Mt de charbon par année (6,0 Mt de la mine Quintette et 1,7 Mt de la mine Bullmoose) est fourni aux clients du Japon.

Le présent rapport résume les discussions qui ont eu lieu avec les représentants des deux mines et fait ressortir les domaines de recherches qui pourraient être effectuées afin d'accroître la productivité dans les mines.

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INTRODUCTION

The Northeast B.C coal block has been under study for many years by many various companies including: Quintette by Denison Mines, Sukunka by British Petroleum, Bullmoose by Teck Corporation, Monkman by Petro Canada, and others. Location of these are shown in Fig.1. Besides Quintette and Bullmoose, no other project materialized due to a slump in the coal export market. At the present both mines are geared for full production. Initially, Quintette experienced some problems with coal quality caused by complex geology but that has been resolved now by better interpretation of the structure. The geology of the Bullmoose property is quite simple with gently dipping coal seams and there was no difficulty in reaching full production in targetted time. Currently, Quintette is in the process of renewing their contract and is under pressure for a cut in volume as well as price. Bullmoose has another two years before their contract expires.

BULLMOOSE COAL PROJECT

GENERAL

The Bullmoose coal project is located 87 km south of Chetwynd and 40 km from the new town Tumbler Ridge. The mine has a fifteen year contract with the Japanese steel industry to supply 1.7 Mt per year of metallurgical coal.

The mine commenced production in 1983 and produced its first million tonnes in 1984. Currently, it is producing its contractual volume. The property has some oxidized coal suitable for electrical power generation. Some of this coal has been sold on the spot market and negotiations for additional purchase with Pacific Rim countries are in progress.

GEOLOGY

There are two major coal bearing areas called the South and West forks. These areas lie along the axis of a broad syncline approximately 2 km in width with gentle dips (3 to 8 degrees) to the northwest. The five seams, which are present in both areas, vary in thickness from 1.3 metres to 4.9



Fig. 1 Coal Region of Northeastern B.C. (1)

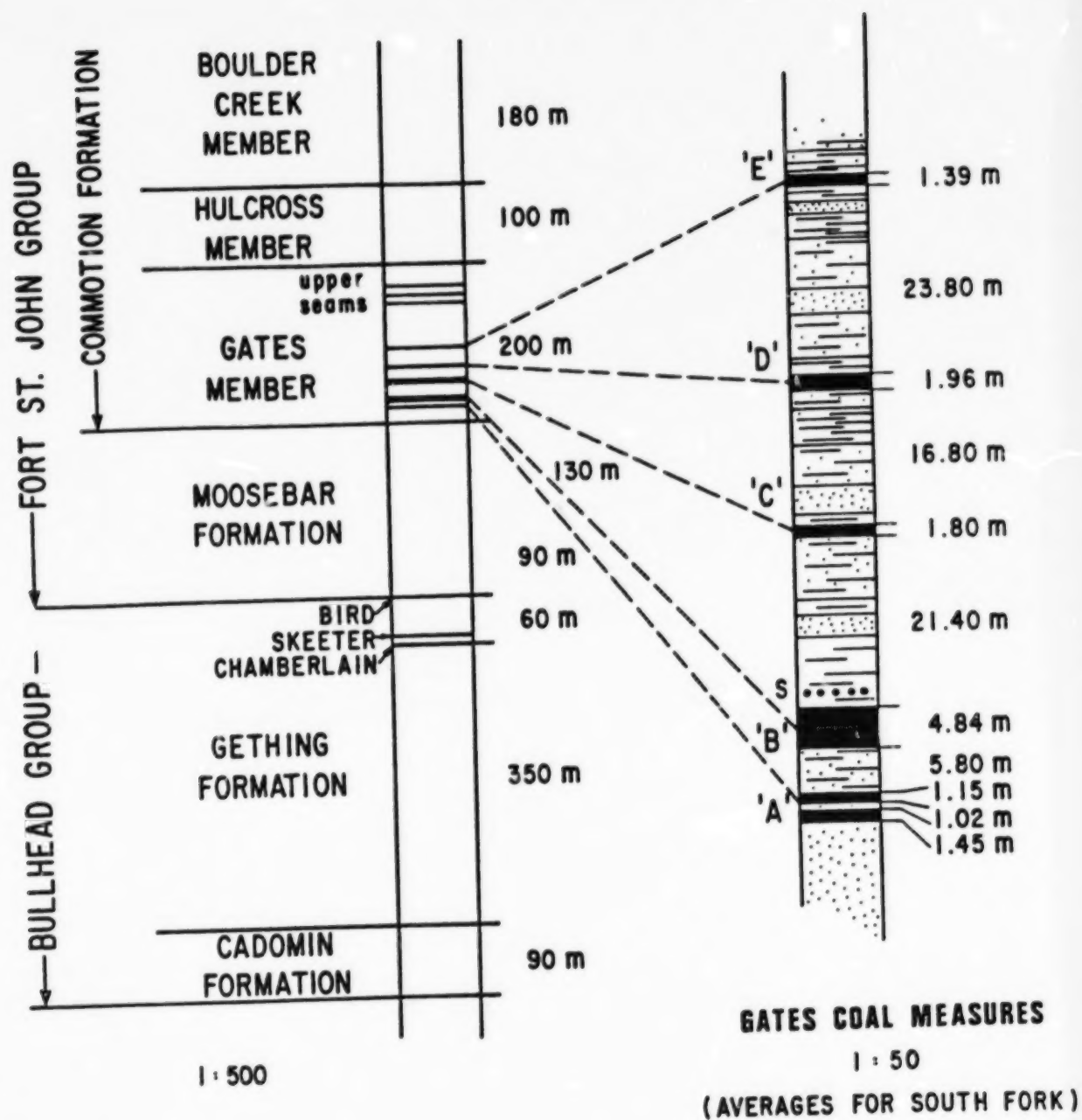


Fig. 2 - Stratigraphic Section - Bullmoose Mine. (1)

metres, with a total combined thickness of 12.4 metres (Fig.2). The total in-place coal reserves is about 80 million tonnes.

MINING METHOD

The mining method is an open pit, conventional truck/shovel operation. It operates two twelve hour shifts per day, seven days per week. The mining activity is confined to one pit in the south fork which contains the major part of mine reserves. Pre-stripping and mining commenced at the north end and the pit is worked up dip of the seams in a southerly direction. The stripping ratio averages 6 b m³ of waste to 1 tonne of raw coal.

The overburden is blasted with ANFO in 270 mm diameter holes drilled using three Ingersol-Rand rotary blast hole drills. The broken rock is excavated by a combination of three P&H-2100 BLE mining shovels equipped with 12.3 m³ buckets and two Marion-3560 backhoes with 12.3 m³ buckets. Coal is mined by Cat 992C front end loaders. All haulage of waste and coal is handled by twenty Komatsu 120 ton mechanical drive off-highway trucks. The waste is dumped in mined out pits as well as on external dump sites. Figure 3 shows a mining schematic of the pit. Nearly 10 M (bank)m³ of waste is handled per year.

RESEARCH POTENTIAL

Blast Casting

The gentle slope of seams and the quality of rocks in the strata indicate good potential for blast casting to reduce the cost of waste handling. In the pit all five seams are mined. The interburden between 'B' and 'C' seams is about 21 metres which could be directly casted into the mined out pit of 'A' seam. This was discussed with the mine officials. They were also informed about CANMET's current cooperative demonstration project with Fording Coal Ltd. to test the usefulness of this technique in Canadian conditions.

Vision Problem

It has been found from experience that on an average about 10 to 12 days per year the mine operation is forced to shut down due to poor visibility caused by dense fog. A similar problem is also faced by other



Fig. 3 - Pit Production Mining Schematic, Bullmoose Mine. (1)

mines located in the mountains. It was agreed that a co-operatively funded project could be initiated to study this problem and find remedial measures.

QUINTETTE COAL PROJECT

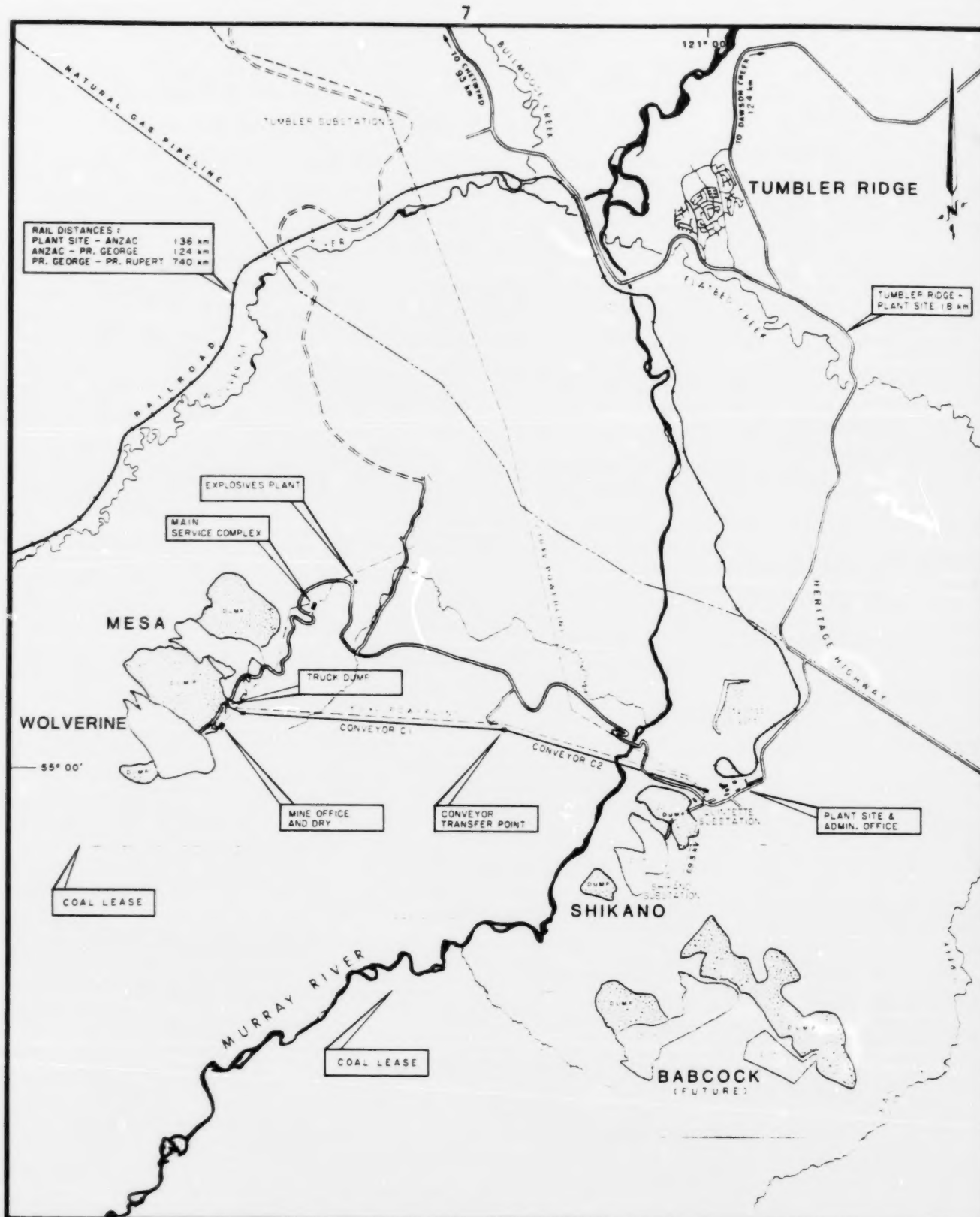
GENERAL

The Quintette coal mine is located near Tumbler Ridge in northeastern British Columbia (Fig.4). Reserve estimates for the property has been recently revised to 162 Mt of proven and probable recoverable product. The designed capacity of the mine is 6.3 Mt per year. The mine produced 5.2 Mt in 1986 of which only 4.75 Mt was sold. All the production came from the Mesa and Wolverine pits. Total amount of coal and waste moved amounted to 41 M (bank)m³.

To meet contract commitments, a new reserve area called the Shikano Pit was opened in the last quarter of 1986. Here, some 350,000 b m³ of pre-strip waste has been removed and a production of 1 Mt of clean metallurgical coal is expected to be reached by the end of 1987.

The Quintette work force at the end of 1986 was 1405 employees compared with 1527 at the end of 1985.

The property has a complex geology causing difficulty in mining which results in high production cost. Additionally, the cost of transporting coal to tidewater at Prince Rupert, is very high. Any savings on coal delineation and extraction, material handling, equipment utilization etc. would prove beneficial for the operation.



GEOLOGY

The Quintette coal property lies within the Peace River Coalfield, in the Rocky Mountains. It is traversed by numerous thrust faults making the structure very complicated (Fig.5). The economically significant coal measures occur within the Gates member of Commotion formation belonging to the Fort St. John group of Lower Cretaceous strata.

Two areas are identified for mine development. In one area, there are six persistent coal zones located within a shallow syncline. On the northeast side it is bounded by thrust faulting. The aggregate thickness of coal seams is in excess of 18 m within a 90 m section of mainly shales and siltstones. In the other area four or five seams with an aggregate thickness of 18 m have been identified. The structure consists of two contiguous synclines with limbs dipping from 15 to 30°. The dip of the seams vary from zero to 90°.

MINING METHOD

Due to the variation in thickness and orientation of seams, four different mining methods are utilized at this operation. Figure 6 shows typical application of these methods. Sub methods are also used in support of and in conjunction with each method. Bench development is normally staged to provide several coal and waste faces. This facilitates the utilization of equipment and provides flexibility in the coal extraction sequence which is essential for blending. The different methods are:

Method - I: A single bench mining with cable shovel and dozer. This is applied in the large overburden block in front of seam D, in the interburden blocks between seams E and F, G2 and J1 in Wolverine pit and between seams G and J in the Mesa pit.

The pit is developed in 10 m benches. Rock is blasted with ANFO in 311 mm holes on a pattern of 9 m x 9 m. The shovel excavates the waste working along the strike direction. Dozers are used to push the heaved waste. Subsequently, the coal is dozed and loaded out with a wheel loader (Fig.7). Approximately 35 % of the coal mined is produced by this method.



Fig. 5 - Coal Section and Structure, Quintette Mine. (4)

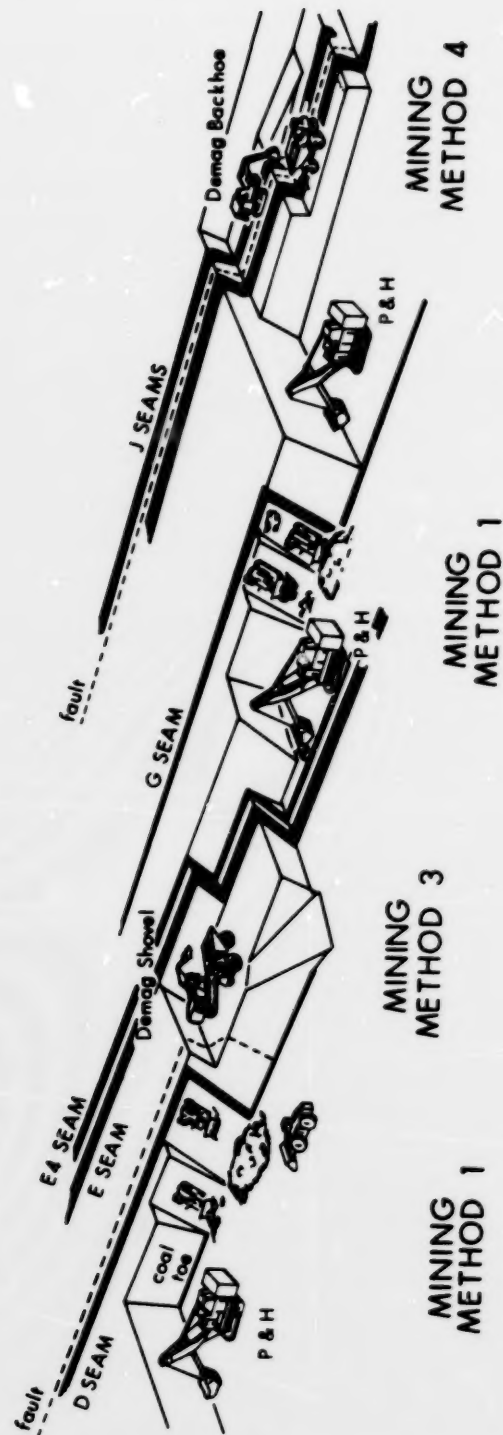


Fig. 6 - Typical Applications of Mining Methods in Mesa Pit. (5)

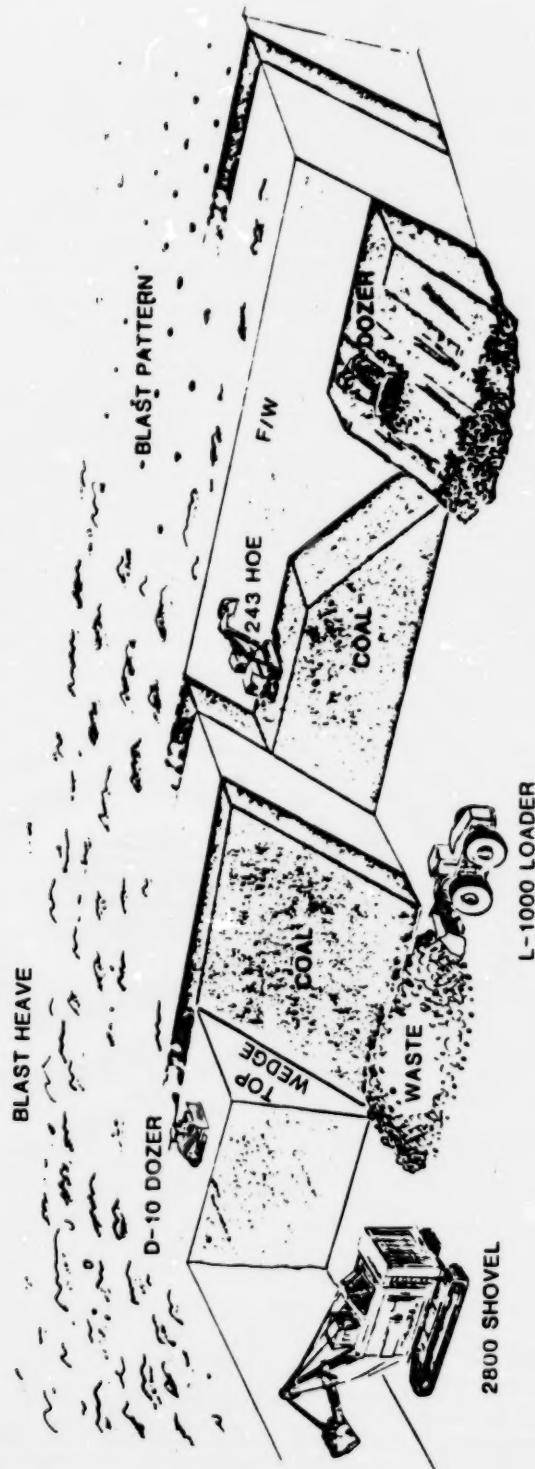


Fig. 7 - Mining Methods - I P & H 2800 (4)

Method - II: Single bench mining with hydraulic front shovel. It is used in Mesa pit in areas where the seams are dipping from 50 to 90° with thin interburden layers. The benches in 10 m height are developed by hydraulic shovels. The burden above and below the seam as well as in-seam partings above 1 m thickness are blasted. The shovel, due to its variable digging angle feature, cleans the waste rock off the seam and later excavates the seam with much less dozer assistance than the cable shovel (Fig.8).

Method - III: Double split mining with hydraulic front shovel. This method is utilized where seams dip between 20-50° and the interburden is very thin. A standard 10 m bench is drilled and blasted, swelling to 13 m. Excavation is similar to Method-II with the exception that waste and coal are loaded out from two horizons. The splits could be either 5 m each bench or vary as much as 4 m and 6 m. This is explained in Fig.9. The reduced working height at the face and the ability of the hydraulic front shovel to excavate almost all the waste and coal without dozer assistance, improve coal recovery. About 38 % of coal is mined by this method.

Method - IV: Triple split mining with backhoe. This method is applied to areas where seam dips are erratic due to folding and faulting. Similar to Method-III, a standard 10 m bench is prepared, drilled and blasted. The heaved waste pile is then levelled off by a dozer to form a pad for the hydraulic backhoe. The excavator advances a face of 5 m, its maximum effective reach. Splits greater than that seriously affect the productivity. A second and third split are mined in sequence thereafter to complete load out of both the waste and the coal. Where the coal is thick (greater than 3 m), the backhoe can mine perpendicular to strike in the hanging wall. Nearly 12 % of the total production is mined by this method.

WASTE DUMPS

In this property, topography and environmental concerns limit the availability of space for mine waste dumping. Nearly 95,000 b m³ per day of waste is required to be removed from the pit. There are eight dumps, 5 in Mesa and 3 in the Wolverine pit area located on steep mountain sides. The dump height is 250-300 m, and the crest length is 100-120 m with slope angle

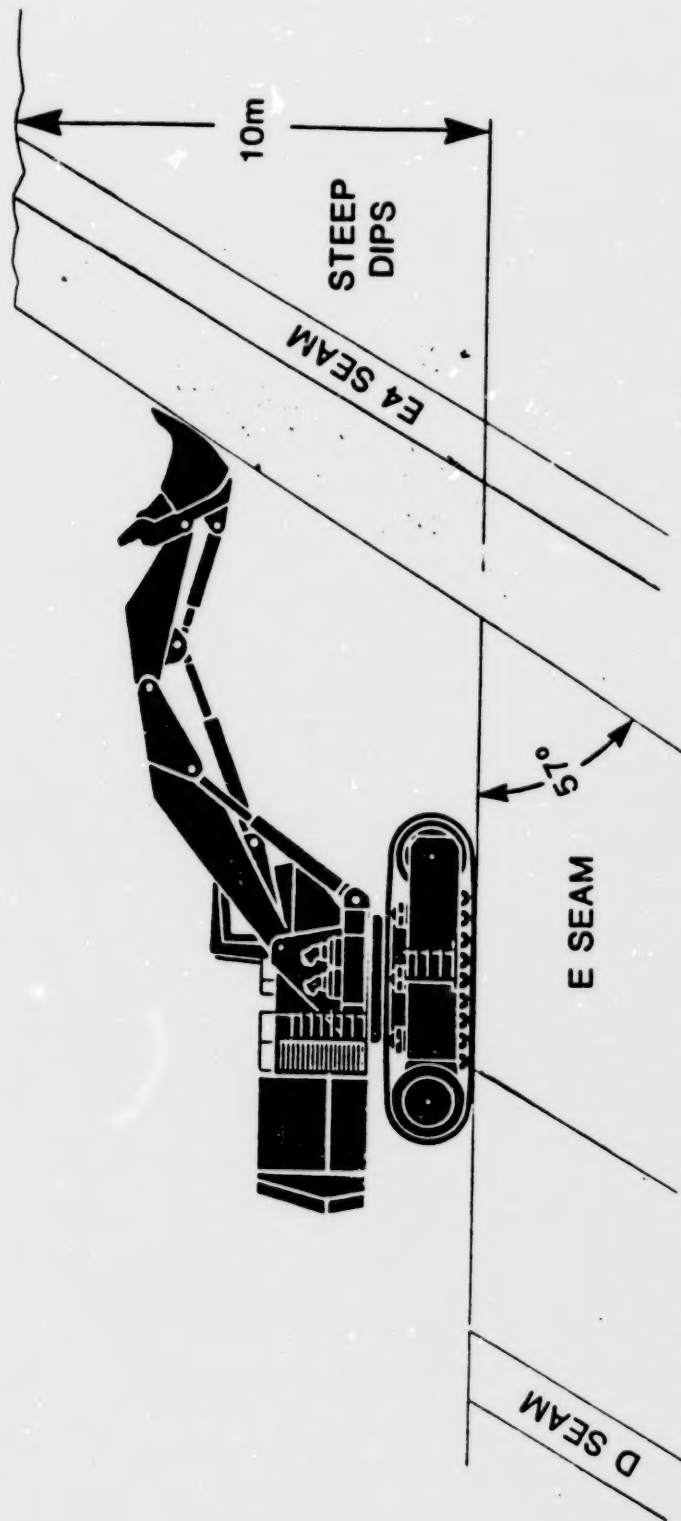


Fig. 8 - Mining Methods - II, DEMAG 241 Front Shovel. (2)

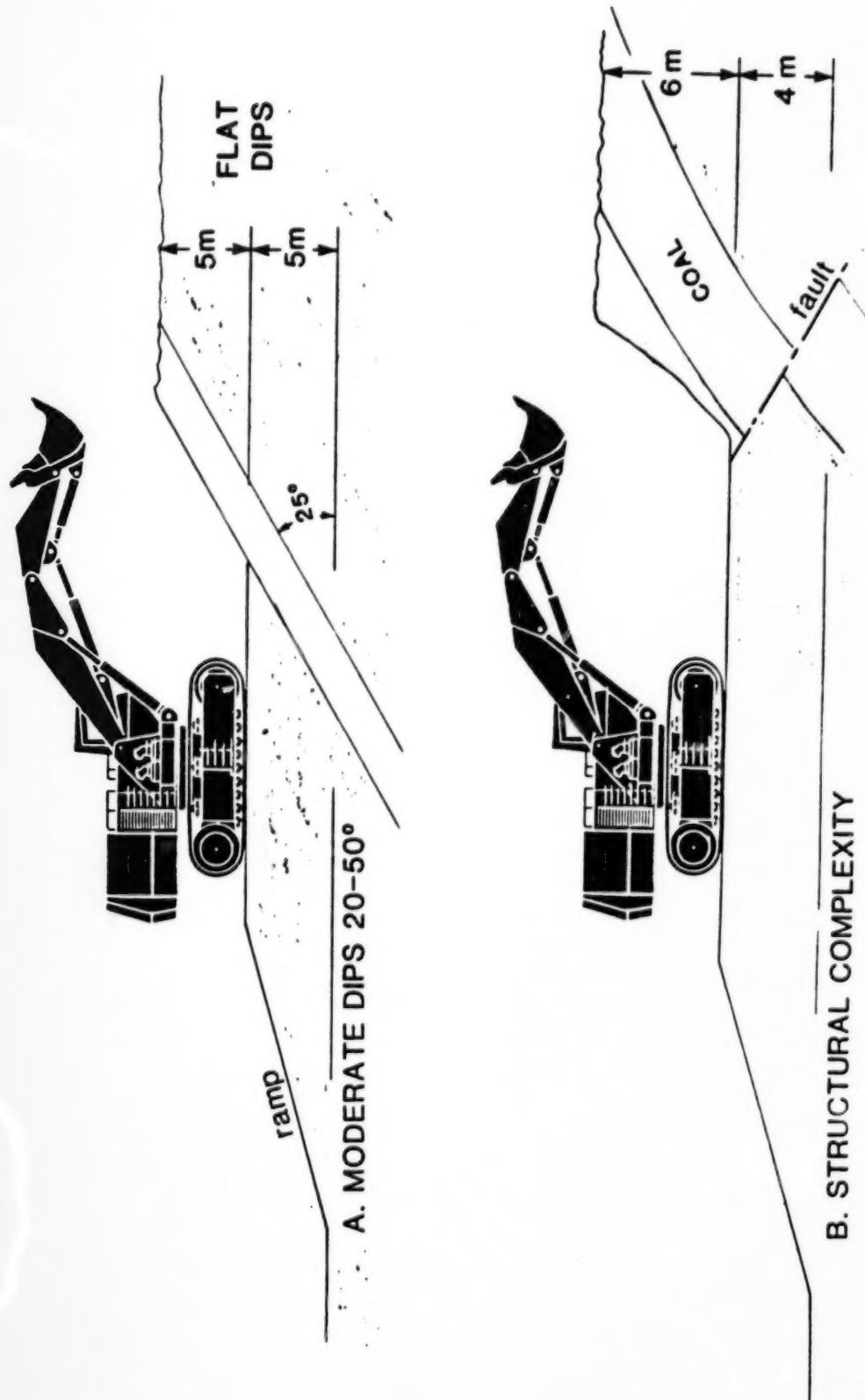


Fig. 9 - Mining Methods III, DENAG 241 Front Shovel, Split Bench. (4)

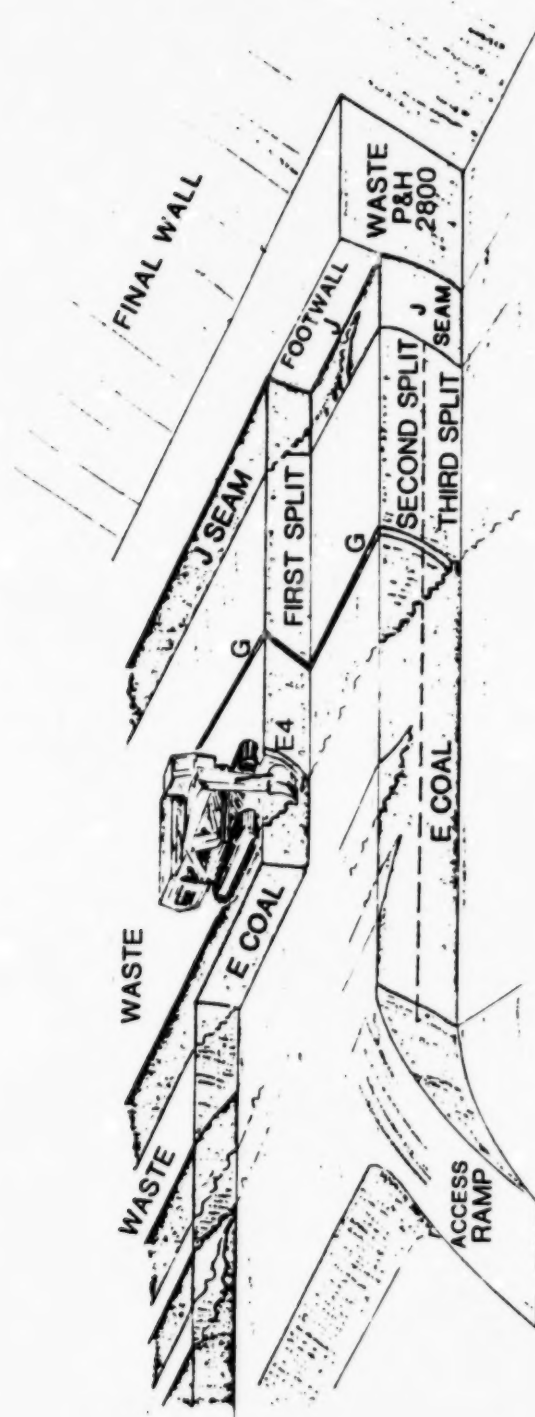


Fig. 10 - Triple Split with DEMAG 241 Backhoe. (4)

between 36 to 37 degrees. Wire extensometers are installed on the dumps to record its movements. The guidelines for dumping are:

- when the movement is less than 2 cm in 24 hours regular dumping is allowed,
- when the movement is greater than 2 cm in 24 hours dumping is restricted to away from the edges and dozers are used to push it, and
- dumping is suspended when the movement exceeds 5 cm in 24 hours.

COMPUTERIZED TRUCK DISPATCH SYSTEM

It is extremely difficult to organize and utilize the mining equipment manually because of the complexity of mining systems and demand for different blends of coal. Consequently, a computer-controlled truck dispatching system has been introduced which has improved the performance of all excavators and of the truck fleet. In addition to controlling the assignment of trucks for coal loading and blending, it also monitors and controls delivery of waste to each of eight dumps, to ensure acceptable dumping rates are not exceeded.

RESEARCH REQUIREMENTS

Vision Problem

The problem of poor visibility caused by dense fog is similar to Bullmoose mine. CANMET made the same suggestion for a cooperatively funded project to study this.

Waste Dump Monitoring

At the present time the dumps have been provided with instrumentation but the readings are taken manually at certain intervals. CANMET suggested that continuous monitoring is possible with a Telemetry system for which expertise can be provided if requested.

COMMON RESEARCH AREAS

REVIEW OF EQUIPMENT MAINTENANCE PRACTICES

A major factor influencing productivity is the availability and utilization of mining equipment. An effective equipment maintenance program

can save millions of dollars. With this objective we strongly feel that it is an opportune time to review the existing equipment maintenance practices, policies and approaches in different coal and oil sands mines. The importance of this work was explained to the mine management. It is proposed to hold a meeting with industry representatives at Devon to discuss a co-operative research program. Management of both mines responded positively.

Microprocessors for Equipment Performance Monitoring

In spite of a regular preventive maintenance program breakdowns do occur. To minimize the breakdowns and also to improve safety, it is important to monitor the equipment to ascertain the actual operating conditions. With this timely action it would be possible to prevent damage to equipment and avoid any production loss. In the last five years, microprocessor technology has found its acceptance in mining for monitoring equipment performance. CANMET/SML has already completed an overview of different systems which are available and are in use at different mines. It is planned to send a copy of this report to all surface coal and oil sands mine operations along with a questionnaire. The objective is to assess the state of the art of this technology in Canadian surface mines and to get a general consensus of the industry representatives on future line of action in this regard.

CONCLUSIONS

The visit was extremely useful and opened up several areas requiring R & D effort. Possible projects identified are:

- Blast casting at Bullmoose mine
- Investigation and finding remedial measures for the vision problem experienced at both mines
- Demonstration of telemetry system at Quintette mine

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